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Sahara® **Leak Location**

Water Loss Levels from Transmission Mains In Urban Environments

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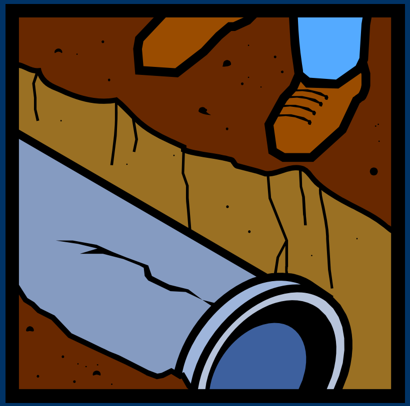
Outline

- Urban Leak Detection Approaches
- Technologies for Small Mains
- Case Studies In Trunk Main Leakage Assessment
- Bringing the Data Together
- Conclusions

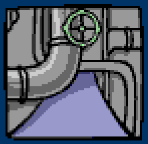
Urban Leak Detection Approaches

- Urban centers are faced with:
  - The oldest water infrastructure
  - Heaviest traffic, placing added stress on pipes
  - The highest consequences of failure
- Political pressure can lead to a reactive spiral
  - Tight budgets prevent replacement of infrastructure when its design life is over
  - Further aging of infrastructure leads to more failures, further stretching the budgets



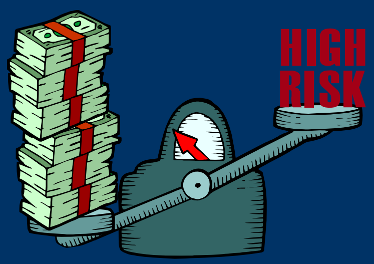
Addressing Leakage

- Proactive leak management offers a path out of the reactive spiral, by:
  - Reducing lost water, leading to increased revenue and lower operations costs
  - Reducing pipe breaks, reducing the need for reactive maintenance
  - Extending the life of some pipelines, allowing capital budget to be used more efficiently



Nice idea. Does it work?

- How much water is actually being lost due to leakage?
- How many leaks are there per mile of mains?
- How much water to these leaks lose?
- How much can be recovered with active leak detection?
- Is it financially beneficial?
  - What are the costs?
  - What is the value of the benefits?
- Apply a cost-benefit model presented at AWWA ACE in 2008 to the case studies presented

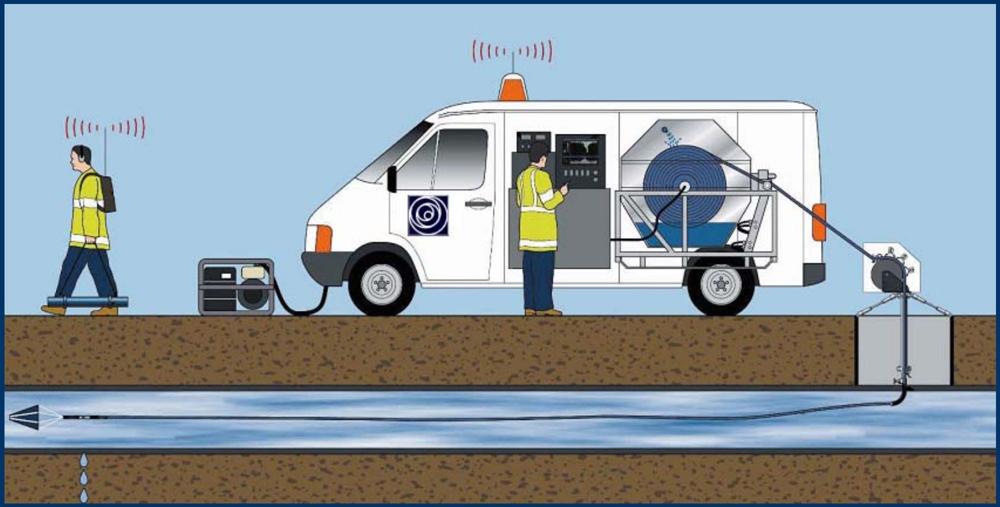


Technologies for Small Mains

- Acoustic Leak Detection
- Metering
- Noise Correlation

Trunk Main Leakage Case Studies

- Thames Water, UK
- Dallas, TX
- Allentown, PA
- Philadelphia, PA
- Montreal, PQ
- Toronto, ON



Tethered inline leak location – proven sensitivity

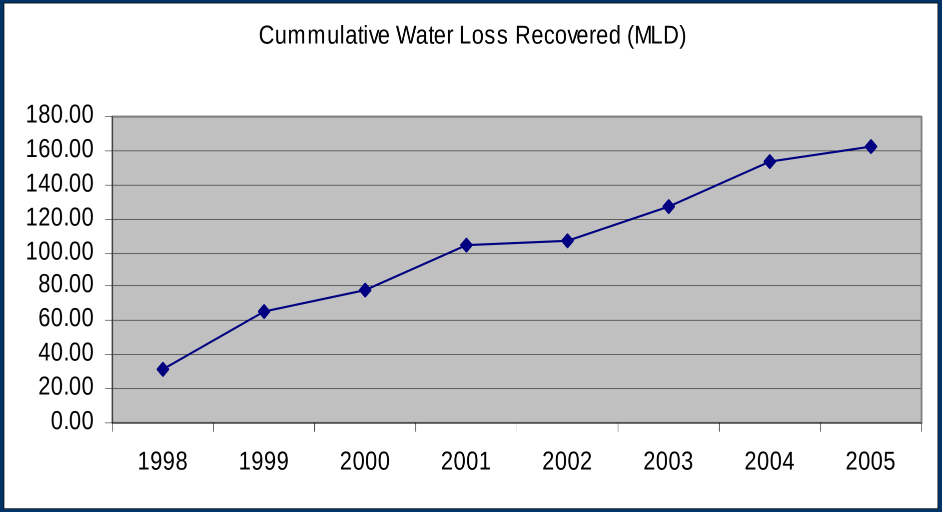
Thames Water, UK

Distance Surveyed	392 miles
Leaks Located	1,250 leaks
Average Size	40,000 gallons per day
Leak Frequency	3.2 leaks / mile

- Program details:
  - Pioneer in transmission main leak detection
  - Measured 400 leaks to get average size of 40,000 g/d per leak
  - Strained water supply, and high water rates
- Leakage Cost/Benefit Model shows net benefit of over $1 Billion
  - ROI of over 4,000%

Thames Water Conclusions

- Recovered over $1 Billion worth of water
- Recovered as much potable water as a medium sized treatment plant would produce
- Water supply is under considerable pressure
  - Demand is exceeding supply in summer
  - Minimal additional raw water sources available
  - Addressing leakage is vastly cheaper than desalinization



Dallas Water Utilities

Distance Surveyed	22.0 miles
Leaks Located	43 leaks
Average Size	81,000 gallons per day
Leak Frequency	2.0 leaks / mile

- Program details:
  - started in 2005
  - Addressed 22 miles
  - Located 43 leaks
  - Leakage rates were measured, and totaled 3.5 MGD
  - Price of Water is $1,410 / MG (lowest retail tier)

- Leakage Cost/Benefit Model shows net benefit of > $18 M
  - ROI of over 1,000%

Allentown, Pennsylvania

Distance Surveyed	2.8 miles
Leaks Located	10 leaks
Average Size	50,000 gallons per day
Leak Frequency	3.6 leaks / mile

- Project Details:
  - Single 2.8 mile main supplies the city
  - No redundancy; a failure on this main would mean a major supply outage
  - Limestone bedding susceptible to being eaten away by water over time
  - Metering suggested the presence of at least one leak
  - Leak detection revealed 10 leaks, which were repaired
- Leakage Cost/Benefit Model suggests that savings from avoided breaks alone was over double the total cost of addressing leakage
  - Total return on investment of over 3,000%
- Replacement of the line was also deferred due to improved confidence in line's condition

Philadelphia Water District

Distance Surveyed	6.8 miles
Leaks Located	18 leaks
Average Size	TBD gallons per day
Leak Frequency	2.6 leaks / mile

- Pilot project using tethered inline leak location started in 2007
- In first 6.8 miles addressed, located 18 leaks
  - Included two leaks on 48” lines deep underground, crossing underneath a major highway
  - These leaks were previously suspected, but could not be located with traditional leak location equipment
- Leakage Cost/Benefit Model shows that total costs were more than recovered in savings from avoided breaks
  - Also shows a huge net benefit, with an ROI of over 1400%

Montreal & Toronto, Canada

- Montreal, Canada:
  - Project included a 1-mile line expected to be in very bad shape
    - Many leaks found on this line, as expected

Distance Surveyed	6.2 miles
Leaks Located	25 leaks
Average Size	TBD gallons per day
Leak Frequency	4.0 leaks / mile

- Toronto, Canada:
  - Project included a 1-mile line expected to be in very bad shape
    - Zero leaks were found on this line. A concurrent video inspection revealed the cement mortar lining to be in much better shape than expected.

Distance Surveyed	2.6 miles
Leaks Located	0 leaks
Average Size	N/A gallons per day
Leak Frequency	0.0 leaks / mile

Bringing the Data Together

- Global Leakage averages
- Regional Leakage averages
- Material Considerations
- The Financial Picture
- Conclusions

Global Leakage Averages

- Combine published data from the UK with data provided by the authors from North America
- Average leak size on trunk mains shown to be between ***20,000 and 50,000 gallons per day***
  - Some large leaks reported at ten times these levels
- Global average of ***2.2 leaks per mile*** on large diameter water mains
  - Such leaks are more common than previously thought

Regional Leakage Averages

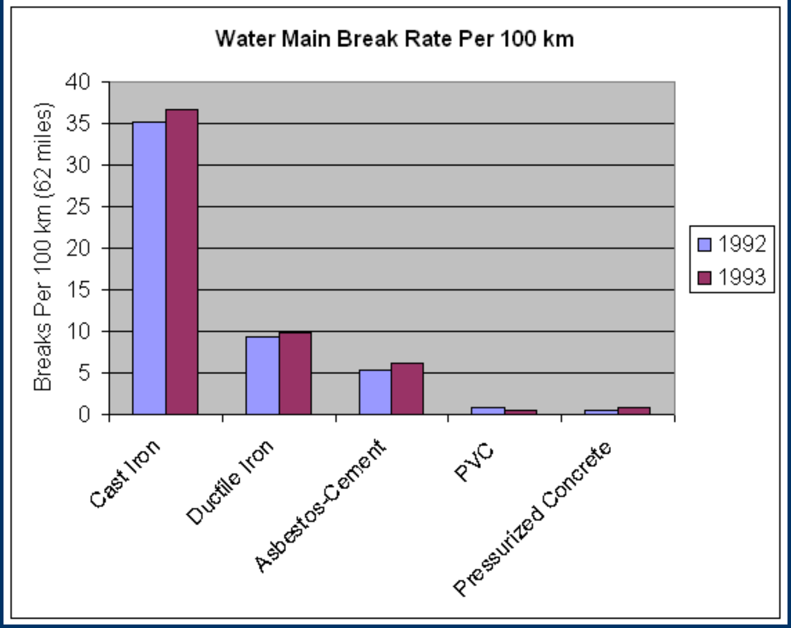
Region	Miles	Leaks	Leaks / mile
North America (Urban)	85	122	1.4
North America (Rural)	89	40	0.4
UK	400	1272	3.2
Morocco	179	210	1.2
Portugal	13	26	2.0
Australia	16	32	2.0
Worldwide	782	1,702	2.2

- Ranges from 0.4 leaks / mile in rural North America, up to 3.2 leaks / mile in the UK (most data from London)
- General trends apparent: older networks and urban centers tend to have higher leakage rates

Material Considerations

- Materials have wide range of leak rates
- Insufficient data on plastic pipes
- General trend of leak rates is similar to published trend for break rates

Material	Miles	Leaks	Leaks / mile
Cast Iron	109	453	4.2
Ductile Iron	11	19	1.7
Steel	68	148	2.2
Concrete	247	253	1.0



Final Water Mains Break Data on Different Pipe Materials for 1992 and 1993, NRC Canada

Conclusions: Large Mains

- Leaks on large mains lose a tremendous amount of water
- Empirical results suggest they are far more common than was otherwise assumed
- Leakage Cost-Benefits Model suggests typical net benefits are huge
  - Typical net returns of $500,000 to $1,000,000 / mile
  - Return on investment consistently over 1,000%
- Total cost of addressing leakage is generally recovered from avoided breaks alone
- Typical costs per mile are only a few percent of the typical benefits, meaning little risk is taken

- **You get a better return on investment by locating leaks in transmission mains**

Sahara® Leak Location

Questions?

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